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WORKING WITH NATURE

TO ASSURE MAN OF A FUTURE SUPPLY OF CLEAN WATER

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BACKGROUND

Water is one of the most important and widely distributed of all substances. Three-fourths of the earth surface is covered by water, either in the liquid state or as ice in colder regions. Large quantities of water are present in the soil, and in the form of vapor it is an essential component of the atmosphere. The human body is about 65-70 percent water. Aquatic plants and jellyfish are approximately 95 percent water. Practically nothing is absolutely dry.

Water is the most widely used of all chemical substances. For this reason we should understand its properties. At $4^{o}C$, water reaches its maximum density.

Almost all substances, except water, have greater density as solids than liquids. If ice were denser than water, surface ice would settle to the bottom. Any large body of water would become a block of ice with a puddle of water at the top. Instead, because of this unusual property, the ice which forms remains on the surface and, to some degree, insulates the water below, thereby protecting the fish and other organisms which live there.

All natural waters contain varying degrees of dissolved minerals. Even the water which falls to earth in the form of rain contains particles of

dust as well as small quantities of gases absorbed from the atmosphere. Upon reaching the earth's surface it dissolves mineral matter present in the rocks and soil, such as common salt and compounds of calcium, magnesium and iron. Water containing such substances in solution is commonly spoken of as hard water or, if large amounts of mineral matter are present, mineral water. The quantity and nature of the substances present vary with the composition of the rocks and soil with which the water comes in contact. Generally surface water such as that found in rivers, streams and lakes is high in minerals such as calcium and magnesium and is therefore called hard water. Whereas, ground water drawn from deep wells along the Gulf Coast area is low in calcium and magnesium and high in sodium with low levels of unpleasant smelling sulfides. As the water slowly filters deep into the earth, minerals such as calcium and magnesium are exchanged for minerals such as sodium and potassium. The sulfates associated with the calcium and magnesium are also converted to odorous sulfides by bacteria that thrive in deep well water where there is no oxygen.

The water of the ocean contains over 3.5 percent mineral matter, more than three-fourths of which is common salt.

The air takes water vapors (fresh water) from the surface of salt water oceans and deposits them on land in the form of snow and rain. The content of water vapor in the air is very important and variable. Over large bodies of water the lower layers of the air tend to become saturated with water vapor. As the air moves over land and becomes cooler this vapor forms rain

or snow. The relative degree of saturation at a given temperature is termed humidity.

When ordinary air is cooled sufficiently, it becomes saturated and, at a slightly lower temperature, deposits dew. The saturated vapor pressure of water has a definite value for each temperature. An example: Air with a relative humidity of 64% at 20°C will reach dew point (100% saturation) at 13°C.

After nightfall, the temperature of the air usually falls. This cooling is more pronounced on a clear night when there are no clouds to prevent the rapid radiation of heat. Often, especially when the humidity is high, the air is cooled below the dew point. The excess water vapor is deposited as dew or, at low temperatures, as frost.

With approximately 95% of the water on earth being salt water in the oceans and a large percent of the fresh water being frozen at the North and South Poles, man has a very limited quantity of fresh water for his many uses.

As the earth becomes more populated and industrial development increases, a world wide water crisis is developing. The demand for more fresh water and the increasing pollution of the present, limited water supply with human waste and industrial toxic chemicals is causing the development of this water crisis.

The treatment of domestic sewage and removal of hazardous chemicals from contaminated water is a problem confronting communities and cities

throughout the United States and other countries. Wastewater treatment is an integral part of the water crisis that is emerging throughout the world. Even areas of the U.S. and other parts of the world with a plentiful supply of water are facing problems because the water is becoming contaminated with sewage and/or hazardous chemicals. Therefore, one of the most urgent environmental needs in the world today is a simple, low cost means of wastewater treatment and water reuse.

A promising means of utilizing vascular aquatic plants for wastewater treatment has been investigated by NASA and other scientists during the past 16 years.

A great deal of success has been achieved in utilizing higher plants and microorganisms in developing low cost wastewater treatment and recycling processes. The use of artificial marshes for treating both domestic and industrial wastewater will be discussed in this report.